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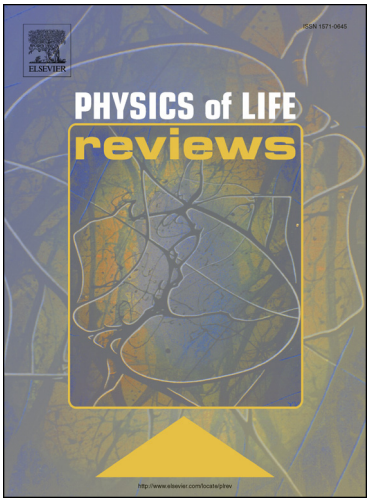

Considering context and variability when observing other minds

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Considering context and variability when observing other minds: Comment on "Seeing mental states: An experimental strategy for measuring the observability of other minds" by Cristina Becchio et al.

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We commend Becchio and colleagues [1] for laying out clearly the conditions under which mental states might be observable. We particularly appreciate the way in which the authors have constrained the definition of 'direct perception' such that their strategy "does not require perception to be that smart for it to be direct" [1, section 6].

Our comment focuses on two issues. The first is the importance of contextual information and other previous experience in constraining the observer's intention judgement. The second relates to the crucial role of individual differences in both actors and observers.

1. Contextual Information and Previous Experience

1.1 Context-dependent associations influence the actor's behaviour and the observer's response

Extensive previous research from the associative learning tradition has shown that context-dependent associations influence behaviour [10; 9] as well as influencing responses to observed behaviours [4; 7]. In the example of understanding intentions from observing others' actions, in a 'drinking' context (table laid out for tea-time; [7]) the stimulus 'cup' would be associated with the 'drinking' action and thereby with the underlying 'to drink' intention. In a 'tidying' context (messy table after tea), the same stimulus would be associated with the 'tidying' action and intention. Thus contextual cues should modulate the observer's intention choice.

1.2 Previous experience can influence judgements regarding action kinematics

We have recently shown [2] that previous experience influences how an observer interprets another's action kinematics. Participants completed an action understanding task in which they judged the weight of boxes lifted by another person, before and after a period of 'counter-mirror' sensorimotor training. During this training, participants lifted heavy boxes while observing light boxes being lifted, and vice-versa. Training significantly reduced participants' performance on the action understanding task, indicating that experience can alter the judgements that an observer makes regarding another's action kinematics.

1.3 Implications for the strategy

In relation to the strategy proposed by Becchio and colleagues for measuring the observability of mental states [1], these results indicate that contextual information and previous experience are important aspects influencing mental state perception. We suggest that these aspects need to be integrated into the strategy in order to reflect how kinematics, and therefore intentions, are perceived in different situations.

Specifically, we propose that both contextual information and previous experience will affect the starting point z in the drift diffusion model [1, section 4.2]. Depending on the observer's previous contextual associations, when an action is presented within a certain context, the starting point of the observation will be biased towards the associated intention. For example, in a 'drink' context, the contextual information will activate context-dependent associations with the 'drink' action kinematics and the underlying 'to drink' intention. Therefore, even when there is no other information indicating what the actor is going to do, the context-dependent associations shift the starting point towards the 'drink' intention, which in turn affects the drift rate v, compared to when the action is observed in other contexts.

Similarly, when considering previous experience, the observer's previous associations between the kinematics of observed actions and the actor's underlying intentions will influence v. As the action starts to unfold, these associations will cause v to accelerate towards the decision boundary previously associated with these kinematics, compared to if there were no prior experience. Crucially, since previous experience will differ between

individuals, the relationship between observed action kinematics and *v* will vary across individuals (see section 2 in this Comment).

Therefore, we recommend that the authors should incorporate this information into steps 2 and 3 of their strategy. The addition of components relating to context-dependent associations and previous experience would take into account how these factors initially constrain the observer's perception of kinematics, as well as the observer's associated intention judgements, which ultimately will determine whether the actor's underlying mental state (in this case, their intention) is correctly perceived.

2. Individual Differences

2.1 Intra-individual variability within the actor

As the authors note, there is considerable variability in motor output, even within one actor producing the same intention from one trial to the next. For example, there are many points in Figure 1 [1] that are closer to the centre of mass of another intention than they are to their own intention. This raises several empirical issues. First, it would be interesting to know how the drift diffusion model in Figure 2 behaves when attempting to classify actions such as those represented by those points. Second, could the model contain a quantification of the actor's variability, and would this help with classifying non-intention-typical actions?

2.2 Inter-individual variability across actors

Becchio and colleagues have previously shown [8] that there are considerable individual differences in action kinematics for the same action across actors. In other words, the mapping from a particular kinematic feature to a particular intention is not constant across actors. It would be interesting to know whether the CART analysis described in step 3 identifies the same kinematic features for intention discrimination across different actors, and whether a model trained on one actor can accurately identify the intentions underlying a different actor's action kinematics. If inter-individual variability is too high to permit accurate cross-actor classification of intentions, then we would predict that observers should show better intention perception for kinematics with which they are familiar. Such a prediction relates to a range of findings, including that participants with atypical action kinematics struggle to identify 'typical' biological motion [3]; that participants with typical action kinematics show reduced ability to identify the mental state expressed by participants with atypical action kinematics [5]; and that one's own action kinematics influence the ability to perceive others' underlying emotional states [6].

2.3 Inter-individual variability across observers

The final source of individual difference is in the observers, who will differ in terms of their mappings from observed action kinematics to the intention choice that they make. Sources of this individual difference include prior experience (as detailed in Section 1 above) as well as observers' own action kinematics (and thus their own associations between kinematics and intentions).

2.4 Implications for the strategy

We encourage the authors to introduce parameters representing individual difference within and between actors, and between observers, into their strategy for measuring the observability of mental states. In terms of practical implications, this should allow the authors to determine to what extent such individual differences would constrain the usefulness of any robotic intention-detection mechanism [1, Box 5].

3. Conclusion

The strategy put forward by Becchio and colleagues [1] is an important starting point for improving the experimental study of the observability of other minds. We suggest that this strategy could be refined further by incorporating contextual information, and by reflecting the constraints that result from variability in both actors and observers.

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Competing interests

The authors have no competing interests to declare.

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